

CLAIMS

1. A spin valve transistor comprising:
an emitter;
a collector;
5 a base between the emitter and the collector;
a spin valve including:
a ferromagnetic free layer structure;
a self-pinned antiparallel (AP) pinned layer structure; and
a nonmagnetic spacer layer between the free layer structure and the AP
10 pinned layer structure; and
the base comprising at least said free layer structure.
2. A spin valve transistor as claimed in claim 1 wherein the base comprises
the free layer structure, the self-pinned AP pinned layer structure and the spacer layer.
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3. A spin valve transistor as claimed in claim 1 wherein the base comprises
the free layer structure, the emitter comprises the AP pinned layer structure and the
spacer layer is located between the base and emitter.
- 20 4. A spin valve transistor as claimed in claim 1 wherein the self pinned AP
pinned layer structure comprises:
a ferromagnetic first antiparallel (AP) pinned layer;
a ferromagnetic second antiparallel (AP) pinned layer;
a nonmagnetic antiparallel coupling (APC) layer located between the first and
25 second AP pinned layers;
one of the first and second AP pinned layers having a cobalt iron (CoFe) film with
a positive magnetostriction; and

the CoFe film having a magnetostrictive anisotropy field that is oriented perpendicular to a head surface of the spin valve transistor for self pinning the AP pinned layer structure.

5 **5.** A spin valve transistor as claimed in claim 4 wherein the cobalt iron is $\text{Co}_{90-50}\text{Fe}_{10-50}$.

6. A spin valve transistor as claimed in claim 4 wherein the first and second AP pinned layers have the same magnetic thickness.

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7. A spin valve transistor as claimed in claim 4 further comprising:
the first AP pinned layer being composed of iron (Fe) and interfacing the spacer layer;

the second AP pinned layer including:

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an iron (Fe) film;

said cobalt iron (CoFe) film;

the iron (Fe) film being located between and interfacing the APC layer and the cobalt iron (CoFe) film; and

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the free layer structure being composed of iron (Fe) and interfacing the spacer layer.

8. A spin valve transistor as claimed in claim 7 wherein the cobalt iron is $\text{Co}_{90-50}\text{Fe}_{10-50}$.

25 **9.** A spin valve transistor as claimed in claim 8 wherein the cobalt iron is $\text{Co}_{50}\text{Fe}_{50}$.

10. A spin valve transistor as claimed in claim 9 wherein the first and second AP pinned layers have the same magnetic thickness.

11. A spin valve transistor as claimed in claim 4 further comprising:

the second AP pinned layer being composed of iron (Fe);

the first AP pinned layer including:

first and second iron (Fe) films with the first iron (Fe) film interfacing the
5 spacer layer;

said cobalt iron (CoFe) film; and

the cobalt iron (CoFe) film being located between and interfacing the first
and second iron (Fe) films.

10 12. A spin valve transistor as claimed in claim 11 wherein the cobalt iron
film is $\text{Co}_{90-50}\text{Fe}_{10-50}$.

13. A spin valve transistor as claimed in claim 12 wherein the cobalt iron
film is $\text{Co}_{50}\text{Fe}_{50}$.

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14. A spin valve transistor as claimed in claim 13 wherein the first and
second AP pinned layers have the same magnetic thickness.

15. A magnetic head assembly comprising:

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a write head;

a read head adjacent the write head;

the read head including:

ferromagnetic first and second shield layers; and

a spin valve transistor located between the first and second shield layers;

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the spin valve transistor comprising:

an emitter;

a collector;

a base between the emitter and the collector;

a spin valve including:

a ferromagnetic free layer structure;
a self-pinned antiparallel (AP) pinned layer structure;
a nonmagnetic spacer layer between the free layer structure and the
AP pinned layer structure; and
5 the base comprising at least said free layer structure.

16. A magnetic head assembly as claimed in claim 15 wherein the self pinned
AP pinned layer structure comprises:

a ferromagnetic first antiparallel (AP) pinned layer;
10 a ferromagnetic second antiparallel (AP) pinned layer;
a nonmagnetic antiparallel coupling (APC) layer located between the first and
second AP pinned layers;
one of the first and second AP pinned layers having a cobalt iron (CoFe) film with
a positive magnetostriction; and
15 the CoFe film having a magnetostrictive anisotropy field that is oriented
perpendicular to a head surface of the spin valve transistor for self pinning the AP pinned
layer structure.

17. A magnetic head assembly as claimed in claim 16 further comprising:
20 the first AP pinned layer being composed of iron (Fe) and interfacing the spacer
layer;
the second AP pinned layer including:
an iron (Fe) film;
said cobalt iron (CoFe) film;
25 the iron (Fe) film being located between and interfacing the APC layer and
the cobalt iron (CoFe) film; and
the free layer structure being composed of iron (Fe) and interfacing the
spacer layer.

18. A magnetic head assembly as claimed in claim 17 wherein the cobalt iron is $\text{Co}_{90-50}\text{Fe}_{10-50}$.

5 19. A magnetic head assembly as claimed in claim 18 wherein the cobalt iron is $\text{Co}_{50}\text{Fe}_{50}$.

20. A magnetic head assembly as claimed in claim 19 wherein the first and second AP pinned layers have the same magnetic thickness.

10 21. A magnetic head assembly as claimed in claim 16 further comprising:
the second AP pinned layer being composed of iron (Fe);
the first AP pinned layer including:
first and second iron (Fe) films with the first iron (Fe) film interfacing the
spacer layer;
15 said cobalt iron (CoFe) film; and
the cobalt iron (CoFe) film being located between and interfacing the first
and second iron (Fe) film.

20 22. A magnetic head assembly as claimed in claim 21 wherein the cobalt iron film is $\text{Co}_{90-50}\text{Fe}_{10-50}$.

23. A magnetic head assembly as claimed in claim 22 wherein the cobalt iron film is $\text{Co}_{50}\text{Fe}_{50}$.

25 24. A magnetic head assembly as claimed in claim 23 wherein the first and second AP pinned layers have the same magnetic thickness.

25. A magnetic disk drive comprising:

- at least one magnetic head assembly that has a head surface;
- the magnetic head assembly having a write head and a read head;
- the read head including:
 - 5 ferromagnetic first and second shield layers; and
 - a spin valve transistor located between the first and second shield layers;
- the spin valve transistor comprising:
 - an emitter;
 - a collector;
 - 10 a base between the emitter and the collector;
- a spin valve including:
 - a ferromagnetic free layer structure;
 - a self-pinned antiparallel (AP) pinned layer structure;
 - a nonmagnetic spacer layer between the free layer structure and the AP
 - 15 pinned layer structure; and
 - the base comprising at least said free layer structure;
- a housing;
- a magnetic medium supported in the housing;
- a support mounted in the housing for supporting the magnetic head assembly with
- 20 said head surface facing the magnetic medium so that the magnetic head assembly is in a transducing relationship with the magnetic medium;
- a motor for moving the magnetic medium; and
- a processor connected to the magnetic head assembly and to the motor for exchanging signals with the magnetic head assembly and for controlling movement of the
- 25 magnetic medium.

26. A magnetic disk drive as claimed in claim 25 wherein the self pinned AP pinned layer structure comprises:

a ferromagnetic first antiparallel (AP) pinned layer;

a ferromagnetic second antiparallel (AP) pinned layer;

5 a nonmagnetic antiparallel coupling (APC) layer located between the first and second AP pinned layers;

one of the first and second AP pinned layers having a cobalt iron (CoFe) film with a positive magnetostriction; and

10 the CoFe film having a magnetostrictive anisotropy field that is oriented perpendicular to a head surface of the spin valve transistor for self pinning the AP pinned layer structure.

27. A magnetic disk drive as claimed in claim 26 further comprising:

15 the first AP pinned layer being composed of iron (Fe) and interfacing the spacer layer;

the second AP pinned layer including:

an iron (Fe) film;

said cobalt iron (CoFe) film; the iron (Fe) film being located between and interfacing the APC layer and the cobalt iron (CoFe) film; and

20 the free layer structure being composed of iron (Fe) and interfacing the spacer layer.

28. A magnetic disk drive as claimed in claim 27 wherein the cobalt iron is $\text{Co}_{90-50}\text{Fe}_{10-50}$.

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29. A magnetic disk drive as claimed in claim 28 wherein the cobalt iron is $\text{Co}_{50}\text{Fe}_{50}$.

30. A magnetic disk drive as claimed in claim 29 wherein the first and second AP pinned layers have the same magnetic thickness.

31. A magnetic disk drive as claimed in claim 26 further comprising:

the second AP pinned layer being composed of iron (Fe);

the first AP pinned layer including:

first and second iron (Fe) films with the first iron (Fe) layer film interfacing the spacer layer;

said cobalt iron (CoFe) film; and

the cobalt iron (CoFe) film being located between and interfacing the first and second iron (Fe) film.

32. A magnetic disk drive as claimed in claim 31 wherein the cobalt iron is $\text{Co}_{90-50}\text{Fe}_{10-50}$.

33. A magnetic disk drive as claimed in claim 32 wherein the cobalt iron is $\text{Co}_{50}\text{Fe}_{50}$.

34. A magnetic disk drive as claimed in claim 33 wherein the first and second AP pinned layers have the same magnetic thickness.